universität innsbruck

Innsbruck Physics Colloquium

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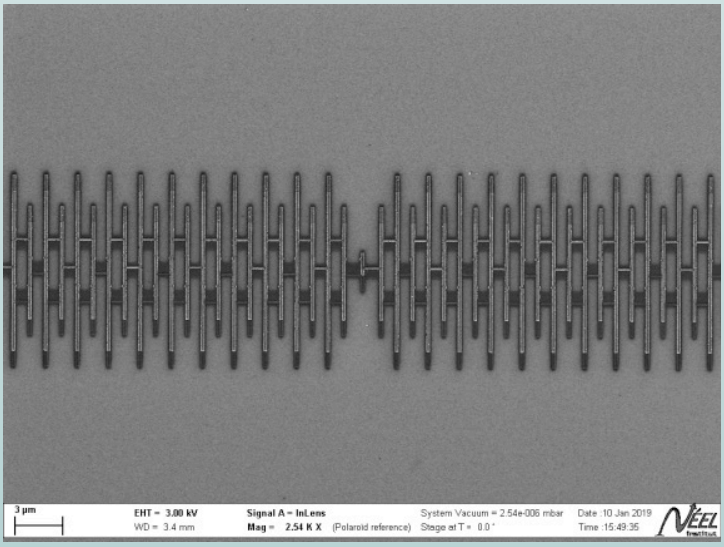
Evidence of dual Shapiro steps in a Josephson junctions array

The modern primary voltage standard is based on the AC Josephson effect and the ensuing Shapiro steps, where a microwave tone applied to a Josephson junction yields a constant voltage $hf/2e$ (h is Planck's constant and e the electron charge) determined by only the microwave frequency f and fundamental constants. Duality arguments for current and voltage have long suggested the possibility of dual Shapiro steps—that a Josephson junction device could produce current steps with heights determined only on the applied frequency. In this talk I will present a device where an ultrasmall Josephson junction is embedded in a high impedance array of larger junctions to reveal dual Shapiro steps. For multiple frequencies, we detect that the AC response of the circuit is synchronised with the microwave tone at frequency f, and the corresponding emergence of flat steps in the DC response with current $2ef$, equal to the tunnelling of a Cooper pair per tone period. This work sheds new light on phase-charge duality, omnipresent in condensed matter physics, and extends it to Josephson circuits. Looking forward, it opens a broad range of possibilities for new experiments in the field of circuit quantum electrodynamics and is an important step towards the long-sought closure of the quantum metrology electrical triangle.



Tuesday, 24.01.2023, at 17:15 h, HS C (Technik)

Innsbruck Physics Colloquium,
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